on the inner surface of the calyx lobes, and ulcers of varying sizes are present in the flower tubules. These tubules are three in number, and extend deeply into the white pulp of the placental area of the ovary.

The Tarsonemus mites do not appear to congregate in any considerable numbers anywhere on the pineapple plant. Yet, I have found them distributed over almost every part of it. When the fruit buds first form, the mites gather between the leaf scales of the tiny tops. Later, as the flowers open, they migrate into the calyx cavities. This is probably the only place that they do any serious harm. Mites belonging to this genus are recorded as pests of strawberries, oats, wheat, grasses, rice, ferns, tea, rubber, peppers, potatoes, sugar cane, etc.

During January, 1929, I experimented with various emulsions, nicotine sulphate, sulfur-tobacco dust, etc., applied to the young tops, before the flowers opened. Several months later, when the fruits were nearly ready to pick, I took careful counts of mite-injured fruit, but could see no appreciable result. The main difficulty is that the mites are so well covered by the closely imbricated parts of the plant that surface applications do not reach them. The best time to apply remedies is undoubtedly when the fruit buds are very young. The mites congregated between the scales of the tiny tops are more exposed than at any other period. It is important, however, to apply treatments before the flowers open.

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## The Black Widow Spider

BY J. F. ILLINGWORTH

(Presented at the meeting of July 11, 1929)

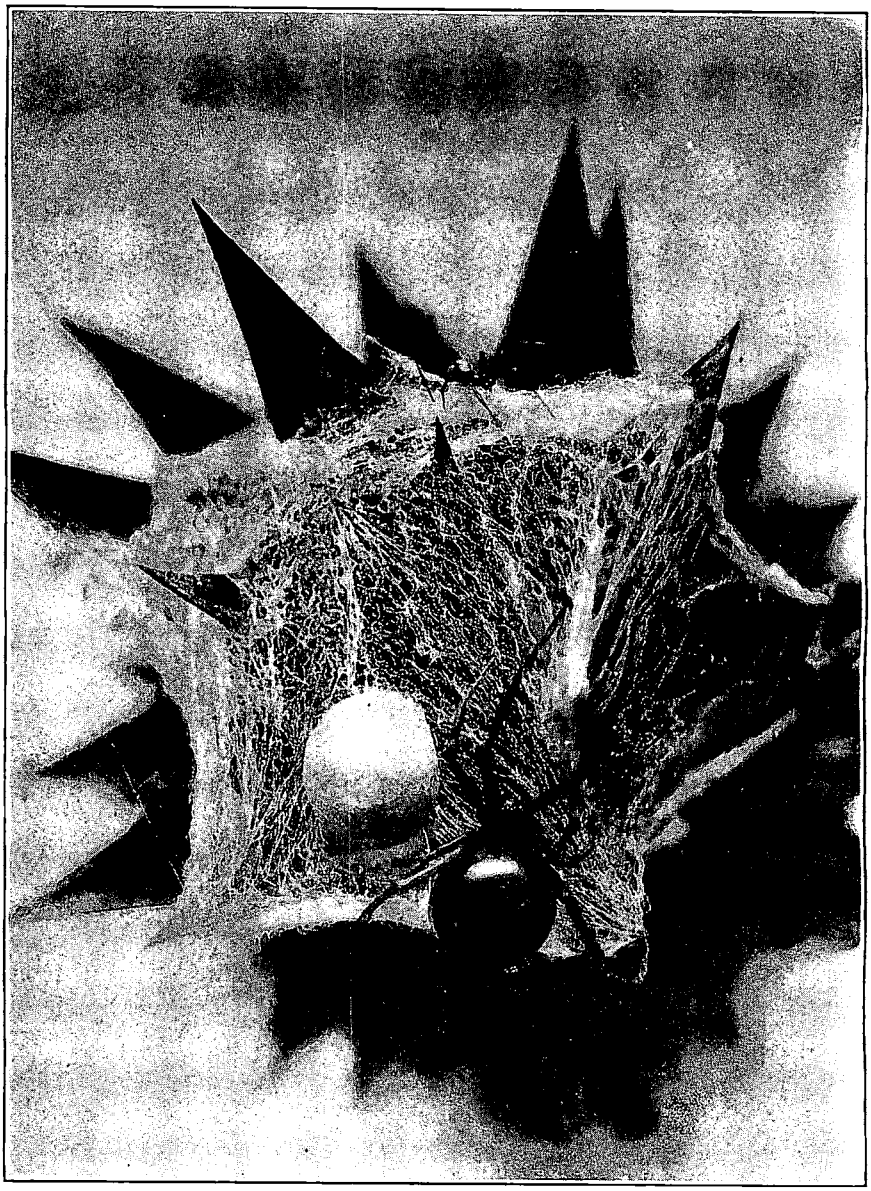
This poisonous species, *Latrodectes mactans* (Fabr.), commonly known as the black widow or hourglass spider, has spread with remarkable rapidity in the islands. It appears to particularly favor pineapple-growing areas, especially where mulching paper is used.

The first record of this pest in Hawaii is by Hadden, who found it at Koko Head November 25, 1925. He later reported finding it at Waikiki. April 16, 1926, I collected specimens in an old pineapple field at Waianae. Soon after, it was discovered by various individuals in widely separated localities, Pearl Harbor, Lanikai, etc.

During my survey of the island of Lanai in August, 1927, the black widow spiders were found to be widely distributed in that new pineapple-growing section. Subsequently, I have observed their remarkable spread on Oahu, extending from Moanalua, Waipio and Wahiawa, to Helemano, and even to the furthest limits of Kemoo. Just recently (September 6, 1929) I found them exceedingly abundant in Kunia fields. This is one of our driest sections, located on the Waianae side of the valley. At the same time, they have been gaining a foothold on the other islands. May 28, 1929, Mr. Jacobson, manager of the California Packing Corporation on Molokai, told me that he had noticed these black spiders in considerable numbers at Kualapuu, a portion of the Cooke's Ranch. In this instance the nests were in fruiting pineapple plants.

This pest undoubtedly came to us from the Coast. Its native home is in the Americas. Records show it ranges all the way from New Hampshire to Patagonia. It is particularly abundant in Mexico. Near relatives of our species occur in the Eastern Hemisphere, especially along the borders of the Mediterranean. The notorious "Katipo" of New Zealand is very similar, as is also the one in North Queensland. The only difference, that I noted, is that some of the red marking is also conspicuous on the back of the abdomen.

The irregular tangled web of the black widow is quite conspicuous, as it surrounds a pineapple plant. Once seen, it cannot be mistaken for any other species common in our fields. The female may be located either in the center of the plant, between the youngest leaves, or down under the mulching paper. She frequently has a retreat ready in both places. It is an easy matter to collect her, for when disturbed she pulls in her legs and becomes quiescent. When full-grown, the female usually has one or more egg-sacs, or cocoons in her home. In one of these, that I opened, I found five hundred and twenty-one eggs. On hatching, the young spiders climb rapidly to the tips of the pineapple leaves. I observed that even a light breeze is able to waft them away, their webs acting as parachutes to transport them long distances. As a matter of fact, this is their main method of distribution. Comstock states that they may be carried hundreds of miles by the wind, as evidenced by their falling upon ships at sea.



Black Widow Spider and Egg Cocoon.

We find, that under favorable conditions, the young grow rapidly, maturing in from one to two months. When confined in a jar, however, they seem to prefer to feed upon their own mates, even when supplied with an abundance of small insects. Under such conditions, the final result was that only two spiders came to maturity—a male and a female. These had destroyed all their mates, and used them for food.

The black widow spider gets her name from her preference of living alone. Males may easily be found in the pineapple fields, but their webs are small and poorly formed, usually placed down on the mulching paper, at the base of the plant. He is a very tiny little creature, about one-fourth the size of his more husky mate. Thus, nature has made it possible for her to devour him, as soon as she has finished with his services.

About one week after mating, the female constructs her first cocoon, in which she places hundreds of eggs. Apparently only one mating is necessary, for once started she is very prolific, forming a new cocoon each week. As many as fifteen of these egg-sacs have been made by one female confined in a glass jar. Since it only requires a month or so for the young to grow up, it is easy to see what tremendous possibilities of multiplication they have. This is especially true under the favorable climatic conditions of the tropics, with few natural enemies present.

From countries where these spiders are found, there are many reports dealing with the venomous character of their bite. These state that the sting causes fatigue for three or four days, sometimes partial paralysis and even death. In order to verify these reports Dr. Nils P. Larsen, head of the Queen's Hospital, Honolulu, experimented on rabbits and guinea pigs. When bitten these animals evidenced pain and appeared to be partially paralyzed and semiconscious. They recovered, however, in from four to six hours—none died.

A very fine article dealing with the black widow spiders appeared in Nature Magazine (N. Y.) for September, 1929. The author, after experimenting on white rats, permitted a spider to bite his finger. He felt a sharp pain, almost immediately, and in twenty minutes it had extended to the shoulder. In about two hours, there was considerable pain in the chest and hips, followed by difficulty in talking and breathing. In about five hours, the

pain had spread to the knees and it soon extended to the toes. All this was accompanied by a low fever. The experimenter found relief by bathing in hot water, and thus spared himself considerable pain. He stated, that it is only under the greatest provocation that the spider can be made to bite humans.

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## The Use of Arsenic in Mosquito Control

BY J. F. ILLINGWORTH

(Presented at the meeting of December 12, 1929)

A matter that has given us some trouble in the greenhouses is the mosquitoes *Aedes aegypti* (Linn.), breeding in our water cultures. I experimented by applying Paris green at the rate of about one part to a million of water. This was very effective in destroying the wrigglers, but the pineapple roots were also injured by it. I then tried lead arsenate, which is only slightly soluble, using the same strength. This gave perfect results. The mosquito wrigglers soon died and there was no apparent injury to roots.

Paris green was first used for the control of Anopheles larvae by M. A. Barber and T. B. Hayne*. Their experiments showed that this chemical was more effective than calcium arsenate, arsenate of lead or arsenious acid. Airplane dusting for the control of malaria mosquitoes began in 1923.** It is now used over extensive areas of marshes by the U. S. Department of Agriculture. Since so small an amount of the poison is effective, some form of inert dust is required as a diluent and carrier. For this purpose a finely ground silica earth found to have about the same density as Paris green, proved very satisfactory; dilution 1 of the poison to 100 of the dust.

Such light applications of Paris green showed no injurious effects upon vegetation in the marshes. Furthermore, the treated waters were proved harmless to stock. My problem in the greenhouses, however, was somewhat different. I had tender pineapple roots suspended in water cultures, usurped by mosquito larvae. The value of the less soluble lead arsenate in such cases has been demonstrated.

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* Arsenic as a larvicide for anopheline larvae. In U. S. Pub. Health Serv., Pub. Health Rept. Vol. 36, pp. 3027-3034. 1921.

** W. V. King and G. H. Bradley. Airplane dusting in the control of malaria mosquitoes. U. S. Dept. Agr. Circ. 367, April, 1926.